



Ferrying Success

How the Washington State Ferry System, the marine industry, and Coast Guard teamed up to deliver a new class of ferry.

by CAPTAIN GREG SUGDEN

New Vessel Construction Master, Washington State Ferry System

The Washington State Ferry (WSF) System is the largest ferry system in the United States, operating 29 vessels at 20 terminals serving Puget Sound (Figure 1). Its vessels range in size from 100-foot, passenger-only vessels to the 460-foot, Jumbo Mark II vessels, capable of transporting 220 cars and 2,500 passengers. In all there are nine different classes of vessels.

Washington State Ferry System crewmembers often rotate work among different classes of vessels. Each person working on a vessel is required to be familiar with the emergency equipment and emergency operations found on his or her vessel, so WSF has strived to standardize its emergency equipment and procedures on all vessels. In the event that any of its vessels need to be abandoned, for example, WSF has a fleet-standard emergency evacuation plan that is the same for all classes of vessels. All WSF vessels are also equipped with Dunlop-Beaufort marine evacuation slides (MES), and all WSF vessel employees receive ongoing training in the operation of these slides.

New Vessel Design, Same Emergency Features

In the spring of 2003, WSF embarked on an ambitious program to build four new 130-car/1,200-passenger ferry boats for use on routes upon Puget Sound. These new vessels would allow the Washington State Ferry System to retire some of its smaller, 75-year-old vessels. WSF worked with a steering committee

consisting of naval architects, professional engineers, vessel operating engineers, and a vessel master to create the vessel specifications. Industry firms, including Glostén Associates, Elliot Bay Design Group, and Jensen Maritime Consultants, were represented on the steering committee, each firm taking responsibility for one area of the vessel design.

One priority was to design a new ferry that would still incorporate the standard emergency operations design of existing WSF vessels. Mr. Will Nickum, P.E., a senior naval architect at Elliott Bay Design, was directed to create a deck arrangement that would closely mirror other WSF car ferries.



Figure 1: Washington State Ferry System route map.

Design Clarification

During the very early stages of the design work, WSF contacted the local U.S. Coast Guard Marine Safety Office (MSO) for an informal review of the vessel arrangement drawings. At that meeting, the MSO representatives noted that the standard WSF vessel design would no longer meet regulations for new vessel construction and, in particular, would not meet the guidance found in Navigation and Vessel Inspection Circular (NVIC) 9-97, "Guide to Structural Fire Protection."

For WSF purposes, NVIC 9-97 provides definitions of open and enclosed vehicle decks and requirements for passenger egress to embarkation areas. By the definition found in NVIC 9-97, the

vehicle decks on WSF vessels are considered enclosed vehicle decks and, as such, areas of passenger egress or refuge must be structurally isolated from the vehicle spaces. The current WSF practice of moving passengers from the passenger cabin, down the stair towers, across traffic lanes, and into the marine evacuation slides would not be allowed in any new construction.

After this initial meeting WSF officials set up a meeting with the U.S. Coast Guard Marine Safety Center (MSC) in Washington, D.C., to receive further clarification regarding the regulations. I attended this meeting in my capacity as WSF new vessel construction master, along with Mr. Nickum and Mr. Olof Sander, WSF senior naval architect. It was our intention to convince MSC of the wisdom of our design and to receive approval to maintain our original arrangements. At the meeting we described how we had arrived at the current design of our new ferry. While the MSC group understood our desire to maintain fleet conformity, they ultimately informed us that our design could not be approved, based upon current regulations, which are in place for the safety of passengers and crew and, therefore, cannot be compromised.

An Impasse, Passed

The MSC staff did offer a possible solution. As noted in 46 Code of Federal Regulations (CFR) 70.15-1 Conditions Under Which Equivalents May be Used, WSF could propose an equivalent arrangement. However, due to the large scale of the design and the significance of the potential equivalency, WSF would need to perform a complete performance-based fire protection engineering analysis. In encouraging us to pursue this option, the MSC personnel also suggested something that we felt was extraordinary. They offered to participate with our design team to find an acceptable solution to our problem.

Representatives from the MSC Major Vessel Branch formed part of the design team and were our contact people throughout the process. Mr. Sander, Mr. Nickum, and I were the WSF team members. We decided early on that we would also need someone to guide us through the process, and we contracted Mr. Andy Grenier, P.E., a fire protection engineer working for Rolf Jensen and Associates. He would be responsible for conducting all of the engineering analyses and writing a final report of the findings, with suggestions for design improvements.

Design Back on Track

Since this was a new process, some guidelines had to be established. The Coast Guard made very clear to us

from the beginning that this would not be a rubber stamp approval. We were expected to perform a fire safety analysis that would evaluate our proposed design for equivalency and then evaluate any mitigating design features that would be proposed.

The design team decided to use NVIC 3-01, "Guide to Establish Equivalency to Fire Safety Regulations for Small Passenger Vessels (46 CFR Subchapter K)," as a guide for this project. Even though WSF vessels are Subchapter H and not considered small passenger vessels, we agreed that the equivalency process outlined in NVIC 3-01 is applicable to a wide variety of projects.

The first question that needed to be answered was how would WSF evacuate passengers from the vehicle deck and into life rafts, if there were a fire on the deck? The vessel design must:

- protect passengers and crew from injury when evacuating the vessel during a fire;
- limit the spread of fire and smoke; and
- provide protection to crew responding to the fire.

To achieve these goals, we would need to provide an adequate safe refuge for all passengers for one hour. This refuge area must also have direct access to the embarkation deck.

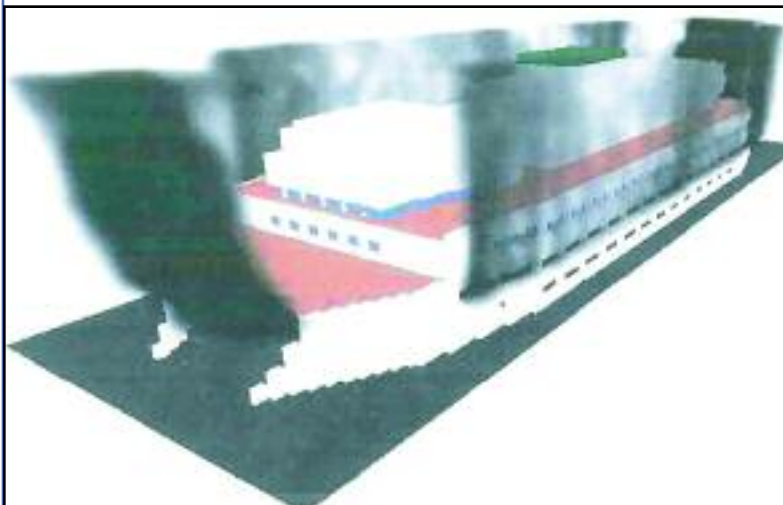


Figure 2: A fire model view of smoke spreading from the openings in the vessel side shell and ends, based on an 80-megawatt bus/truck fire located in the midship portion of the center vehicle tunnel. Courtesy WSF New 130-Auto Ferry Fire Analysis Report, Rolf Jensen and Associates.

The Process

Mr. Grenier developed a computer fire model for the proposed vessel design. This fire model simulated various fires, which allowed the team to analyze what areas

of the vessel would be affected by heat and smoke during various fire scenarios (Figure 2). After analyzing the heat and smoke spread of the design fires, the vessel design team made modifications to the original vessel design. The fire model was then re-tested to verify the results. The design team successfully incorporated some major new design features to address safety issues, while maintaining the current standard WSF deck layout, with MES located on the lower car deck.

These added safety features included roll down A-0 class doors that completely separate the four MES embarkation areas from the central vehicle tunnel, which is where the computer modeling showed the largest fires could be expected to occur. The design also incorporated an automatic early fire detection system for the car deck, as well as an enhanced fire suppression system for the car deck that exceeds all current regulatory requirements for vessels of this class.

exceeds all existing fire safety requirements (Figure 3). Instead of simply imposing its regulatory will upon us, the U.S. Coast Guard showed a willingness to work in a cooperative manner that allowed us to succeed.

The success of this project would not have been possible without some basic principles:

- 1. Start early.** The WSF team was fortunate in that we decided to get Coast Guard comments very early in the design stage. Since we started early, there was no delay in the design process, even though we needed to complete the fire safety analysis.
- 2. Be flexible.** We learned early on that we would not get everything that we wanted and would have to make modifications that affected the entire design.
- 3. Keep the dialogue flowing.** There was never a phone call or e-mail that went unanswered.
- 4. Find the right teammates.** WSF was very fortunate to

work with Mr. Nickum and Mr. Grenier. Both men had the knowledge and professional expertise to find the right solutions to help guide us through the process. MSC representatives were fair and open-minded individuals who provided invaluable assistance to us in getting to a successful end product. The Coast Guard Office of Lifesaving and Fire

Protection also provided valuable guidance and material review from the very start of the project.

Would we do this again? It depends. WSF certainly feels that more research is needed in the area of vessel fire safety. As it is, most of the studies and tests that are available are based on shore-based fires such as those in tunnels and garages. The concessions that we made to our design should not be precedent-setting for future ferry construction projects. But, if during future construction projects, WSF still feels the need to maintain the current design standard, WSF would most definitely like to continue the course set by this project and would not hesitate to team up with the U.S. Coast Guard.

About the author: Captain Greg S. Sugden has worked for Washington State Ferries for 26 years. During that time he has been in both licensed and unlicensed positions on all WSF vessels and routes. He is currently the Construction Master representing the WSF Operations Department for New Vessel Construction.



Figure 3: Drawing of the new WSF 130-auto, 1,200-passenger ferry. Drawing prepared by Gary Olsen, WSF Vessel Design.

Success

The entire process took several months to complete. There was continuous dialogue between MSC and WSF team members over what should be analyzed or how a certain result should be interpreted. The MSC team members offered useful suggestions based on their knowledge of the regulations, and we offered suggestions based on our operational experience. At times there were disagreements, which could usually be settled with meaningful dialogue. When a solution or compromise could not be found, it would fall to the MSC team members to remind us of the regulatory requirements and insist upon compliance. During these times we realized that, although we may be a "team" with MSC, all teams have a captain.

But there is no arguing with the outcome of this project. WSF was able to maintain its current design standard while designing a new vessel that actually